

ANDROSCOGGIN RIVER BASIN
RUMFORD, MAINE

**MOUNT ZIRCON RESERVOIR DAM
ME-00244**

**PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM**



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**DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154**

OCTOBER 1978

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:

NEDED

JAN 08 1979

Honorable Joseph E. Brennan
Governor of the State of Maine
State Capitol
Augusta, Maine 04330

Dear Governor Brennan:

I am forwarding to you a copy of the Mount Zircon Reservoir Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

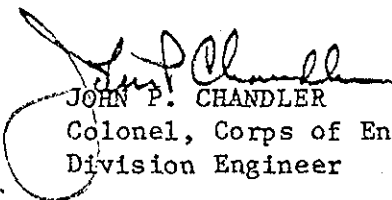
A copy of this report has been forwarded to the Department of Agriculture and the Department of Transportation, cooperating agencies for the State of Maine. In addition, a copy of the report has also been furnished the owner, the Rumford Water District, Rumford, Maine 04276, ATTN: Mr. Hector LeCours, Superintendent.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Agriculture and the Department of Transportation for your cooperation in carrying out this program.

Sincerely yours,

Incl
As stated


JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

MOUNT ZIRCON RESERVOIR DAM

ME-00244

ANDROSCOGGIN RIVER BASIN

RUMFORD, MAINE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

ME-00244

MT. ZIRCON RESERVOIR DAM

RUMFORD

OXFORD COUNTY, MAINE

ZIRCON BROOK

AUGUST 1, 1978

BRIEF ASSESSMENT

The Mt. Zircon Reservoir Dam is an earth embankment dam about 900 feet in length and 55 feet in height. The dam has a stone masonry spillway and concrete gate house inlet structure. The purpose of the dam is storage of potable water for the town of Rumford.

Based on the visual inspection and the compilation of available data, the dam is judged to be in good condition. It is maintained well and no major modifications are deemed necessary to assure the long-term safety of the structure.

The spillway will pass a 100-year flood event. However, based on its intermediate size and significant hazard classification in accordance with the COE guidelines, the test flood falls between the 1/2 PMF and PMF. The spillway capacity of the dam is approximately 22 percent of the probable maximum flood.

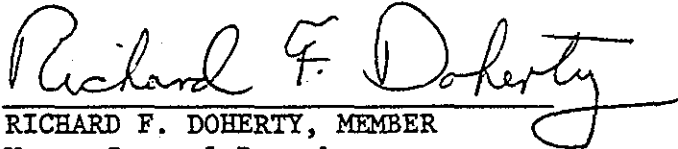
Although no major modifications to the dam appear necessary several operating and maintenance procedures as outlined in Section 7.3a, should be implemented within 24 months after receipt of this report by the owner. Items of particular importance are 1) regrading of the dam crest, 2) harvesting of trees on the downstream slope and 3) the development of a plan for around-the-clock surveillance during periods of high anticipated run-off and for a formal warning system to be used in the event of an emergency.



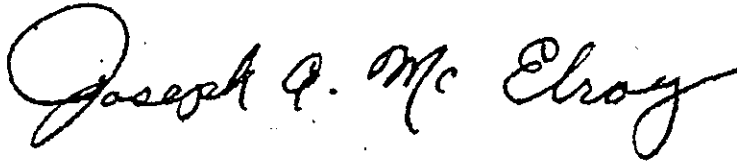
EDWARD C. JORDAN CO., INC.

Stanley E. Walker
Stanley E. Walker, P.E.
Project Manager

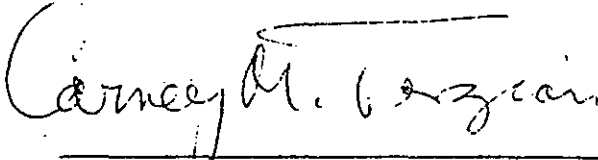
This Phase I Inspection Report on Mount Zircon Reservoir Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.



RICHARD F. DOHERTY, MEMBER
Water Control Branch
Engineering Division

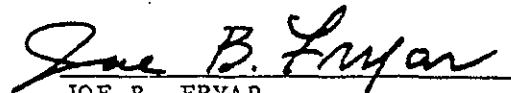


JOSEPH A. MCELROY, MEMBER
Foundation & Materials Branch
Engineering Division



CARNEY M. TERZIAN, CHAIRMAN
Chief, Structural Section
Design Branch
Engineering Division

APPROVAL RECOMMENDED:



JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a

measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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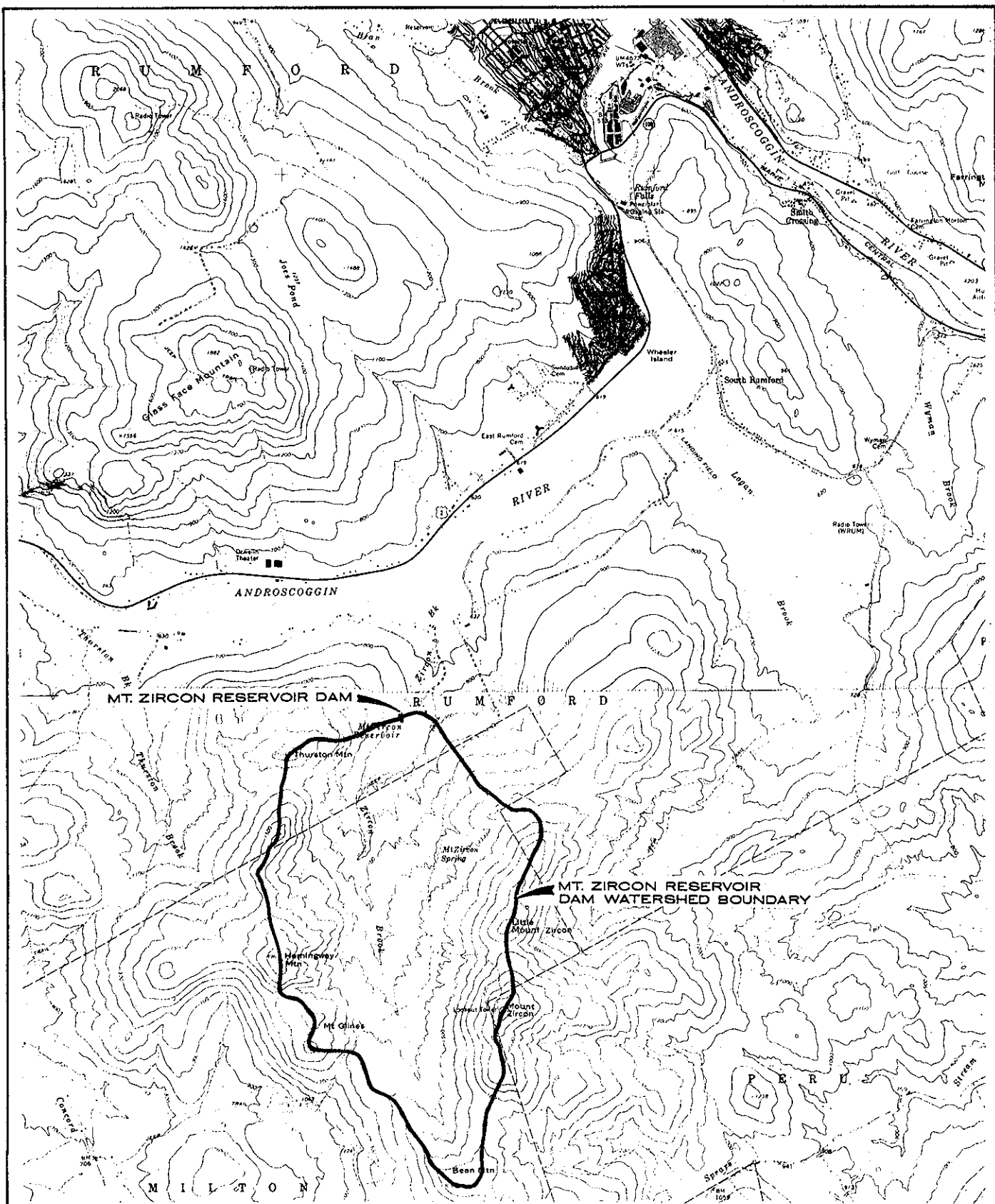
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OVERVIEW



0 2000 4000 6000 FEET



EDWARD C. JORDAN CO., INC. PORTLAND, MAINE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS	
MT. ZIRCON RESERVOIR DAM	
LOCATION MAP	
ANDROSCOGGIN RIVER	MAINE
SCALE AS SHOWN	
DATE SEPT. 1976	

PHASE I INSPECTION REPORT
MOUNT ZIRCON RESERVOIR DAM

SECTION 1

PROJECT INFORMATION

1.1 GENERAL

- a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Edward C. Jordan Co., Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Maine. Authorization and notice to proceed were issued to Edward C. Jordan Co., Inc. under a letter of June 20, 1978 from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0349 has been assigned by the Corps of Engineers for this work.
- b. Purpose
- (1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.
 - (2) To encourage and prepare the states to initiate quickly effective dam safety programs for non-Federal dams.
 - (3) To update, verify and complete the National Inventory of Dams.

1.2 DESCRIPTION OF PROJECT

- a. Location. The Mt. Zircon Reservoir Dam is located on Zircon Brook in the town of Rumford, Maine. It

is about one-half mile south of the Androscoggin River and about 3.5 miles southwest of Rumford N 44°-30', W 70°-34'.

- b. Description of Dam and Appurtenances. The Mt. Zircon Reservoir Dam is an earth embankment dam approximately 900 feet long and about 55 feet in height. It has a concrete core-wall and a stone masonry spillway. The control outlet is a concrete gate house and inlet structure.
- c. Size Classification. Based on height of the impoundment, 55 feet, the Mount Zircon Reservoir Dam is classified as an intermediate sized dam (a range of 40 to 100 feet). The storage capacity at full spillway is about 439 acre-feet.
- d. Hazard Classification. In the event of failure of the Mount Zircon Reservoir Dam, 3 residences, including a farm, would very likely be damaged, and there would be a chance for the loss of lives. Thus the Mount Zircon Reservoir Dam is classified as having a significant hazard potential.
- e. Ownership. The dam was originally constructed for the Rumford and Mexico Water District. The present owner is the Rumford Water District, Rumford, Maine.
- f. Operator. The operator of the Mt. Zircon Reservoir Dam is Mr. Hector LeCours, Superintendent, Rumford Water District, Rumford, Maine, 04276. Telephone Number 1-207-364-8531
- g. Purpose of Dam. The purpose of the dam is storage of a potable water supply for the town of Rumford, Maine.
- h. Design and Construction History. The design of the Mt. Zircon Reservoir Dam was completed by E. Worthington, Engineer, in February 1913. Construction of the dam was completed by James M. McGregor (Contractor) on August 17, 1914 and the basin was first full on February 25, 1915. Modifications were made to the spillway about 1928.

- i. Normal Operating Procedure. The reservoir is operated as a water supply reservoir with a 16-inch diameter gravity service main. There is a 24 inch diameter outlet gate which has not been used since about 1960, and it was not operated during the visual inspection because there was concern that it would not close. Generally, every year the reservoir fills from spring snow melt and overflows the spillway. As summer approaches, the reservoir water surface elevation goes down below spillway crest. Provision for flashboards exists, but they reportedly were only used once during a 2 to 3 year dry period in the 1950's. Flashboards are not presently used.

1.3 PERTINENT DATA

- a. Drainage Areas. The drainage area above Mount Zircon Reservoir Dam is about 2.6 square miles, of which Mount Zircon Reservoir's area is approximately 18.2 acres. The watershed has a rolling topography varying in elevation from about 790 feet to about 2200 feet.
- b. Discharge at Damsite. There is one gate which is 24 inches in diameter. The upstream invert is about elevation 791.7 feet, and the downstream invert is about elevation 790.0 feet. The following are pertinent discharges:
- (1) Maximum known flood (1927) at dam site was about 660 cfs at elevation 843.4.
 - (2) Ungated spillway capacity (total spillway capacity) at the top of the dam is 1130 cfs at elevation 845.0.
 - (3) Ungated spillway capacity at test flood (PMF) elevation is about 1500 cfs at elevation 846.0.
 - (4) Gated spillway capacity is not applicable.
 - (5) Total project discharge at test flood (PMF) elevation is approximately 5200 cfs at elevation 846.0 (crest of dam at elevation 845.0).

c. Elevation. The following is a table of pertinent elevations at the Mount Zircon Reservoir Dam site:

<u>LOCATION</u>	<u>ELEVATION ABOVE MSL</u>
Top of Dam	845.0
Maximum Pool-Design Surcharge	Unknown
Full Flood Control Pool	845.0
Water Supply Pool	840.0
Spillway Crest	840.0
Diversion Tunnel Invert	Not Applicable
Streambed at Centerline of Dam	791.0
Maximum Tailwater	Unknown
Test Flood Elevation (PMF)	846.0

d. Reservoir. The length of the recreation pool and flood control pool is listed below:

<u>LOCATION</u>	<u>LENGTH (feet)</u>
Water Supply Pool	1650
Flood Control Pool	1850

e. Storage. The storage values listed below were taken from a 1915 after construction report by E. Worthington:

<u>ITEM</u>	<u>STORAGE (acre-feet)</u>
Water Supply Pool	307
Flood Control Pool/Top of Dam	439

f. Reservoir Surface. The following are estimated water surface areas for Mount Zircon Reservoir:

<u>ITEM</u>	<u>SURFACE AREA (acres)</u>
Top of Dam/Flood-Control Pool	22.2
Water Supply Pool/Spillway Crest	18.2

g. Dam.

Type - The Mount Zircon Reservoir Dam is an earth embankment structure with a concrete core.

Length - It is approximately 900 feet in length.

Height - The top of the dam is approximately 55 feet above the old streambed.

Top Width - The top width is 10 feet.

Side Slopes - The upstream and downstream slopes are approximately 1.75 horizontal to 1 vertical.

Zoning - The dam was designed with three zones; 1) the upstream zone was to consist of hard pan or gravel mixed with hard pan or clay, 2) the central zone was to consist of reinforced concrete, and 3) the downstream zone was to consist of similar material to the upstream zone except that clear loam or sandy loam could be used.

Impervious Core - A reinforced concrete core was placed in the dam.

Cutoff - The core wall was to be continued down to "ledge or impervious substratum."

Grout Curtain - None.

h. Diversion and Regulating Tunnel. Not applicable.

i. Spillway.

Type - Stone masonry, broad crested weir.

Length - The spillway is 38.5 feet wide at the crest and 39.4 feet wide at a level 2.4 feet above the crest.

Crest Elevation - The crest elevation is 840 (msl).

Gates - The spillway is not gated, however, drill holes for flashboard rods exist.

Upstream Channel - The upstream channel is lined with concrete and stone. It slopes gently from the spillway crest to the pond water level.

Downstream Channel - The downstream channel is a stone (paved) channel about 40 feet wide sloping at 6 percent or greater.

j. Regulating Outlet.

Invert - The invert of the regulated outlet is approximately 791.8 (msl) at the gate house.

Size - The outlet pipe is 24-inch diameter.

Description - The outlet pipe runs from an inlet box in the reservoir through the gate house and outlets at the downstream toe of the dam.

Control Mechanism - The control mechanism is a 24-inch diameter gate valve.

SECTION 2

ENGINEERING DATA

2.1 DESIGN

Design drawings were prepared for the Mt. Zircon Reservoir Dam by Metcalf and Eddy, Consulting Civil Engineers (July 17, 1912). A second set of design drawings from which the dam was constructed, similar to the first, were prepared by E. Worthington, Engineer (February 20, 1913). Copies of these drawings are included in Appendix B with a copy of the "Specifications Contract and Bond" for the project. No design computations are, however, available.

2.2 CONSTRUCTION

Construction of the dam was started in April 1913, and completed on August 17, 1914. The basin was first filled to the overflow spillway on February 25, 1915. Construction history is referenced in Appendix B-5.

2.3 OPERATION

The reservoir is operated as a water supply reservoir with a 16-inch diameter gravity service main. There is a 24-inch diameter outlet gate which has not been used since about 1960, and it was not operated during the visual inspection because there was concern that it would not close. Generally, every year the reservoir fills from spring snow melt and overflows the spillway. As summer approaches, the reservoir water surface elevation goes down below spillway crest. Provision for flashboards exists, but they reportedly were only used once during a 2 to 3 year dry period in the 1950's. Flashboards are not presently used.

2.4 EVALUATION

- a. Availability. Design drawings, contract documents, photographs, and construction reports are available at the Rumford Water District Office.

- b. Adequacy. The available engineering data includes plans and specifications, which together with the results of visual inspection appear adequate for Phase I assessment.
- c. Validity. The physical dimensions of the various elements of the dam were measured during the field inspection and were found to be in reasonable conformance with the available drawings.

SECTION 3
VISUAL INSPECTION

3.1 FINDINGS

- a. General. The dam is an embankment structure situated in a narrow valley between Thurston Mountain and Little Mount Zircon. The dam has a stone masonry spillway located in the west abutment and a concrete gate house, water supply inlet structure. The dam appears to be generally in very good condition.
- b. Dam.
- (1) Structural - The dam is an earth embankment structure with a stone masonry spillway. The visual inspection of the dam resulted in the following major findings:
 - (a) No evidence of general settlement of the embankment was found. Wheel traffic on the dam crest has, however, caused local depressions. Some settlement has occurred behind the walls of the spillway.
 - (b) The embankment slopes appear true to design line and grade. No evidence of major slope instability was found. Some minor surficial sloughing has occurred along the toe of the dam near Station 5+50.
 - (c) Some moderate downslope creep of the riprap slope protection has occurred east of the service bridge below normal pool level.
 - (d) Very minor seepage (total estimated accumulative volume of 5 gpm) is occurring along the toe of the dam from Station 3+50 to 6+00. No piping, boils or erosion was found, however.

- (e) Several groundhog burrows were observed near the crest of the dam on the downstream slope. No recent activity was evidenced.
 - (f) The downstream slope of the dam is wooded with pine trees. Surface cover consists of a sparse growth of ferns and brush in a surface of forest duff and pine needles.
 - (g) The stone masonry spillway is in generally good condition, however the sidewalls have tipped toward the center of the spillway. A small stone lined cavity exists in the outlet channel. The masonry has been pointed but some cracks exist.
 - (h) The 24-inch blow-off pipe is in good condition and true to line and grade.
 - (i) A mineral spring exists below the toe of the dam near the blow-off outlet. Very little or no flow was occurring at the time of inspection.
- (2) Hydraulics - At the time of the visual inspection, the reservoir was at approximately elevation 836.5 feet, about 3.5 feet below spillway crest. The spillway has provision for flashboards, but reportedly flashboards have not been used since 1950 when they were used for 2 or 3 years during a very dry period. The 24-inch diameter gated outlet was not operated because it had not been operated for many years, and there was concern that it would not shut.

c. Appurtenant Structures. The gate house is an appurtenant structure to the dam. It is constructed of reinforced concrete. Some spalling of the concrete has occurred near the water level. Generally the structure is in good condition. The service bridge to the gate house appears to be in good condition structurally but the deck planking is rotted.

Mechanical equipment at the dam consists of gate valves and manual operating equipment, and a hoist for moving the screens in the gate house. The hoist was operated and is in good condition. The gate valves were not operated, but except for the 24-inch blow-off line, the gate valves are operational and are used as necessary for water supply.

- d. Reservoir Area. The outlet from Mount Zircon Reservoir is controlled by Mount Zircon Reservoir Dam which is an earth embankment with a concrete core and mortared stone spillway. Although there was no evidence of siltation near the dam, upstream areas near the inlet of Zircon Brook had about 2 feet of silt buildup, as shown in photograph 7.
- e. Downstream Channel. The downstream channel is formed by a manmade channel which leads from the spillway at the dam to the natural channel about 1000 feet downstream of the dam. Both the manmade and natural channels have a steep gradient (5 to 10 percent) and are rocky.

3.2 EVALUATION

Based on the visual inspection, the dam appears to be in good structural condition. As outlined in Section 7, some maintenance of the facility should be undertaken.

SECTION 4

OPERATING PROCEDURES

4.1 PROCEDURES

The reservoir is operated as a water supply reservoir with a 16-inch diameter gravity service main. There is a 24-inch diameter outlet gate which has not been used since about 1960, and it was not operated during the visual inspection because there was concern that it would not close. Generally, every year the reservoir fills from spring snow melt and overflows the spillway. As summer approaches, the reservoir water surface elevation goes down below spillway crest. Provision for flashboards exists, but they reportedly were only used once during a 2 to 3 year dry period in the 1950's. Flashboards are not presently used.

4.2 MAINTENANCE OF DAM

Grass mowing is done on the crest of the dam frequently. Brush cutting and tree pruning is done periodically or as-needed. Other maintenance, such as work on the gate house or spillway, is done on an as-needed basis. Burrowing animals are exterminated and burrows are filled, when discovered. Reportedly a forester inspects the trees on the downstream slope and recommends necessary action.

4.3 MAINTENANCE OF OPERATING FACILITIES

The gate valves in the gate house are operated as needed. The valves and valve stems are below normal water level and no regular maintenance is done. The 24-inch diameter gate valve on the blow-off line is reportedly no longer used. Concern was expressed by the operator regarding the possibility of not being able to close the 24-inch valve once it was opened.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

No warning system is known to be in effect.

4.5 EVALUATION

The dam is in good repair and regular maintenance is done. No formal warning system is in effect for either high water or structural distress.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

- a. Design Data. Two reports concerning the hydraulics and hydrology of the dam were examined. The reports were written by the designer of the dam, E. Worthington. The first report was written in 1915, less than a year after construction had been completed. The second report was written in 1928 and described the condition of the dam at that time.
- b. Experience Data. Published hydraulic and hydrologic data for Zircon Brook appears to be entirely lacking, except for the two Worthington reports and records kept at the Rumford Water District of monthly average reservoir water surface elevations. In his 1928 report, Worthington made note of the 1927 flood, which reached an elevation of 843.4 feet or 3.4 feet above spillway crest. It is estimated that this 1927 flood flow amounted to about 660 cfs.
- c. Visual Inspection. The outlet of Mount Zircon Reservoir is controlled by Mount Zircon Reservoir Dam which is an earth embankment with a concrete core wall and mortared cut stone spillway. There is a gated 24-inch diameter outlet which is not used. Outflow from the spillway passes into a manmade channel which joins the natural channel about 1000 feet from the dam. Both channels have a steep gradient (5 to 10 percent) and they are rocky with overhanging trees.
- d. Overtopping Potential. The hazard potential was determined by examining downstream areas for possible damage. The failure analysis assumes a breaching of the dam at full spillway capacity. "Rule of Thumb" guidance for estimating downstream dam failure hydrographs as described in an attachment to ETL 1110-2-234 was used as an aid in this analysis. In the event of failure of the Mount Zircon Reservoir Dam, there would be an

inundated flood plain about 1000 feet wide at Mount Zircon Road which would possibly damage 3 dwellings. Because of the danger for loss of life in these dwellings, the Mount Zircon Reservoir Dam is classified as having a significant hazard.

Since Mount Zircon Reservoir Dam is classified as having a significant hazard potential, the dam must be analyzed for passing the probable maximum flood. The probable maximum flood (PMF) has been calculated to be about 5400 cfs, according to Corps of Engineers, "Preliminary Guidance for Estimating Maximum Probable Discharges." Consideration of the effect of surcharge storage (according to "Preliminary Guidance for Estimating Maximum Probable Discharges in Phase I Dam Safety Investigations," March 1978, New England Division, Corps of Engineers) reduces the PMF to 5,200 cfs. The PMF would overtop the dam by about 1 foot. The spillway capacity (excluding gated outlet) is about 1130 cfs, which is about 22 percent of the adjusted PMF.

SECTION 6

STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observation. Based on the visual observations made at the site, the dam appears stable in that no erosion, settlement, horizontal movement or sloughing of slopes is apparent except for some minor downslope creep of the riprap slope protection below normal pool level.
- b. Design and Construction Data. The available plans and specification referenced in Appendix B were reviewed and it was found that the structure conforms reasonably to the line and grade of these documents.
- c. Operating Records. The Rumford Water District keeps monthly average reservoir water surface elevations.
- d. Post Construction Changes. Minor modifications were made to the spillway crest as outlined in a letter to the Rumford and Mexico Water District from Mr. E. Worthington dated September 17, 1928. In 1952, pine trees were planted on the downstream slope of the dam.
- e. Seismic Stability. The dam is located in seismic Zone No. 2 and in accordance with recommended Phase I guidelines, does not warrant seismic analysis.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 ASSESSMENT

- a. Condition. Based on the visual inspection and compilation of available engineering data, the Mount Zircon Reservoir Dam is assessed to be in good condition. The spillway of the dam will pass approximately a 100-year flood without overtopping. The probable maximum flood (PMF) reduced by the effect of surcharge storage is approximately 5200 cfs. The spillway capacity is about 1200 cfs or 22 percent of the PMF. Overtopping of the dam with resulting erosion and breaching of the dam would likely occur under a probable maximum flood event.
- b. Adequacy of Information. Although design plans and specifications for the dam are available, the information is such that the assessment of the condition of the structure must be based primarily on the visual inspection, past operational performance, and engineering judgment.
- c. Urgency. The remedial measures outlined in Section 7.3 below should be implemented within 24 months after receipt of this report by the owner.
- d. Need for Additional Investigation. Additional investigation is not considered necessary.

7.2 RECOMMENDATIONS

The owner should engage a qualified engineer to evaluate further the hydrology and hydraulics of the watershed and dam, and to design additional spillway capacity if necessary.

7.3 REMEDIAL MEASURES

- a. Operating and Maintenance Procedures. The program of regular inspection and maintenance of the dam should be continued and a record of this

program should be kept. The following specific operating and maintenance procedures should be implemented:

1. The stone lined cavity in the outlet channel of the spillway should be refilled with stones and concrete.
2. The masonry spillway walls should be pointed where necessary and the inlet end of the east wall should be relaid.
3. The crest of the dam should be regraded to fill the wheel tracks and other depressions to bring the crest to a uniform grade at elevation 845. Care should be taken to fill all animal burrows. A new turf surface must be established where grading is done.
4. A scheduled program for harvesting the trees on the downstream slope should be undertaken. No brush or ground cover vegetation which would preclude inspection of the slope should be allowed to grow on the slope, and the downstream slope must be protected against erosion.
5. The spalled concrete on the sidewalls of the gate works should be repaired.
6. The condition of the riprap slope protection should be examined at least once each year and whenever the reservoir level is low enough to permit direct observation. Repairs should be scheduled if conditions warrant.
7. The service bridge planking should be repaired.
8. Seepage at the downstream toe of the dam should be monitored and any excess seepage should be noted and corrective measures should be taken as necessary.
9. The 24-inch outlet gate should be repaired to and maintained in operating condition.
10. A program of around-the-clock surveillance should be provided for periods of anticipated high run-off.

10. A plan for a formal warning system which could be used in the event of an emergency should be developed.
11. A periodic inspection of the dam should be made by a qualified engineer at least every five years.

7.4 ALTERNATIVES

Not applicable.

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Mount Zircon Reservoir Dam

DATE August 1, 1978

TIME A.M.

WEATHER Cloudy

W.S. ELEV. 836.5 U.S. 791.0 DN.S.

PARTY:

1. <u>Brian Bisson</u>	6. _____
2. <u>Stephen Cole</u>	7. _____
3. <u>John Kimble</u>	8. _____
4. <u>Ernest Jurick</u>	9. _____
5. <u>Henry Oatley</u>	10. _____

PROJECT FEATURE	INSPECTED BY	REMARKS
1. <u>Geotechnical</u>	<u>Stephen Cole</u>	
2. <u>Structural</u>	<u>Henry Oatley</u>	
3. <u>Hydrology/Hydraulics</u>	<u>Brian Bisson</u>	
4. <u>Survey</u>	<u>John Kimble</u>	
5. <u>Photography</u>	<u>Ernest Jurick</u>	
6. _____		
7. _____		
8. _____		
9. _____		
10. _____		

NOTE: See Supplementary Inspection Notes Following Checklist

INSPECTION CHECKLIST

PROJECT Mount Zircon Reservoir Dam DATE 8/1/78
 PROJECT FEATURE Dam Embankment NAME Stephen Cole
 DISCIPLINE Geotechnical NAME _____

AREA EVALUATED	CONDITIONS
----------------	------------

DAM EMBANKMENT

Crest Elevation	Elevation 840.0
Current Pool Elevation	3.5 feet below spillway crest
Maximum Impoundment to Date	Unknown
Surface Cracks	None observed
Pavement Condition	Turf
Movement or Settlement of Crest	Local, 6" wheel ruts
Lateral Movement	None observed
Vertical Alignment	Okay
Horizontal Alignment	Okay
Condition at Abutment and at Concrete Structures	Some settlement at spillway walls
Indications of Movement of Structural Items on Slopes	None observed
Trespassing on Slopes	Woodchuck borrows
Sloughing or Erosion of Slopes or Abutments	Some sloughing at Sta. 5+50 toe
Vegetation	Trees on embankment, few bushes and ferns

AREA EVALUATED	CONDITIONS
<u>DAM ENBANKMENT</u> (cont.)	
Rock Slope Protection - Riprap Failures	Some downslope creep
Unusual Movement or Cracking at or near Toes	None observed
Unusual Embankment or Downstream Seepage	Minor seepage btw Sta. 3+50 and 6+00
Piping or Boils	None observed
Foundation Drainage Features	None observed
Toe Drains	None observed
Instrumentation System	None

INSPECTION CHECKLIST

PROJECT Mount Zircon Reservoir Dam DATE 8/1/78
 PROJECT FEATURE Outlet Works NAME Brian Bisson
 DISCIPLINE Hydrology/Hydraulics NAME _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</u>	
a. Approach Channel	
Slope Conditions	N/A
Bottom Conditions	Could not observe
Rock Slides or Falls	None observed
Log Boom	None
Debris	None
Condition of Concrete Lining	N/A
Drains or Weep Holes	None observed
b. Intake Structure	
Condition of Concrete	Minor spalling, generally concrete good
Stop Logs and Slots	None

INSPECTION CHECKLIST

PROJECT Mount Zircon Reservoir Dam DATE 8/1/78
 PROJECT FEATURE Outlet Works NAME Brian Bisson
 DISCIPLINE Hydrology/Hydraulics NAME Stephen Cole
Geotechnical

AREA EVALUATED	CONDITION
----------------	-----------

OUTLET WORKS - CONTROL TOWER

a. Concrete and Structural

General Condition	Good, minor spalling
Condition of Joints	Good, minor spalling
Spalling	At water line
Visible Reinforcing	None observed
Rusting or Staining of Concrete	None observed
Any Seepage or Efflorescence	None observed
Joint Alignment	Okay
Unusual Seepage or Leaks in Gate Chamber	None observed
Cracks	None observed
Rusting or Corrosion of Steel	None observed

b. Mechanical and Electrical

Air Vents	N/A
Float Wells	N/A
Gate Hoist	N/A
Elevator	N/A

AREA EVALUATED	CONDITIONS
<u>OUTLET WORKS - CONTROL TOWER (cont.)</u>	
Hydraulic System	N/A
Service Gates	Good condition
Emergency Gates	Not operated, could not observe
Lightning Protection System	N/A
Emergency Power System	N/A
Wiring and Lighting System	N/A

INSPECTION CHECKLIST

PROJECT Mt. Zircon Reservoir Dam DATE 8/1/78
 PROJECT FEATURE Outlet Works NAME Brian Bisson
 DISCIPLINE Hydrology/Hydraulics NAME _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - TRANSITION AND CONDUIT</u>	24-Inch Diameter Drain
General Condition of Concrete	Outlet headwall cracked
Rust or Staining on Concrete	N/A
Spalling	N/A
Erosion or Cavitation	None observed
Cracking	None observed - Steel Pipe
Alignment of Monoliths	N/A
Alignment of Joints	Good
Numbering of Monoliths	N/A

PERIODIC INSPECTION CHECKLIST

PROJECT Mt. Zircon Reservoir Dam DATE 8/1/78
 PROJECT FEATURE Outlet Works NAME Stephen Cole
 DISCIPLINE Geotechnical and Hydrology/ NAME Brian Bisson
Hydraulics

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - OUTLET STRUCTURE AND</u> <u>OUTLET CHANNEL</u>	
General Condition of Concrete	Fair - cracked
Rust or Staining	None observed
Spalling	Some at water line
Erosion or Cavitation	None observed
Visible Reinforcing	None observed
Any Seepage or Efflorescence	None observed
Condition at Joints	N/A
Drain holes	None observed
Channel	Stone-lined, good
Loose Rock or Trees Overhanging Channel	Trees and brush in vicinity of 24-inch drain discharge
Condition of Discharge Channel	Adequate

INSPECTION CHECKLIST

PROJECT Mt. Zircon Reservoir Dam DATE 8/1/78
 PROJECT FEATURE Outlet Works NAME Brian Bisson
 DISCIPLINE Hydrology/Hydraulics NAME Henry Oatley
Structural

AREA EVALUATED	CONDITION
----------------	-----------

OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS

a. Approach Channel

General Condition	Unobstructed
Loose Rock Overhanging Channel	None observed
Trees Overhanging Channel	Reservoir forms approach channel
Floor of Approach Channel	Flat, unobstructed

b. Weir and Training Walls

General Condition of Masonry	Good - minor movement
Rust or Staining	None observed
Spalling	None observed
Any Visible Reinforcing	None observed
Any Seepage or Efflorescence	None observed
Drain Holes	None observed

c. Discharge Channel

General Condition	Good
Loose Rock Overhanging Channel	None observed
Trees Overhanging Channel	Trees lining channel
Floor of Channel	Rocky with one large tree felled in channel
Other Obstructions	None

INSPECTION CHECKLIST

PROJECT Mt. Zircon Reservoir Dam DATE 8/1/78
 PROJECT FEATURE Outlet Works NAME Henry Oatley
 DISCIPLINE Structural/Geotechnical NAME Stephen Cole

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SERVICE BRIDGE</u>	
a. Super Structure	
Bearings	Okay
Anchor Bolts	Okay
Bridge Seat	Good
Longitudinal Members	Okay
Under Side of Deck	Planking rotten
Secondary Bracing	Okay
Deck	Poor, planking rotten, some missing
Drainage System	None
Railings	Good
Expansion Joints	N/A
Paint	Good
b. Abutment & Piers	
General Condition of Concrete	Good
Alignment of Abutment	Good
Approach to Bridge	Good
Condition of Seat & Backwall	Okay

APPENDIX A

FIELD INSPECTION NOTES

1. CONCRETE AND STONE MASONRY STRUCTURES

The only concrete structure at the dam is the gate house inlet structure. The spillway is constructed of mortar laid stone masonry.

- a. Concrete Surfaces. Except for the zone from about elevation 835 to 840 the concrete surface of the gate house is good. Within the zone from elevation 835 to 840, the exterior surface is spalled to a depth of 1 to 3 inches. The area has been previously repaired and since spalled again.

Stone Masonry Surfaces. The surface of the stone masonry in the spillway is in good condition. The masonry has been repointed and the condition of the mortar is generally good.

- b. Structural Cracking. No cracking of the concrete gate house was noted. Some cracking of the mortar joints in the spillway was observed.

- c. Movement - Horizontal and Vertical Alignment. No movement of the gate house was apparent. The side walls of the masonry spillway have deflected toward the center of the spillway. The top of these walls are out of plumb by 3 to 5 inches at the top.

- d. Junctions. The junction of the embankments to the spillway walls shows some subsidence. A 3 to 6 inch deep depression in the embankment about 1 foot wide was observed behind the walls.

- e. Drains. None observed.

- f. Water Passages. The surfaces of the masonry spillway show no signs of erosion, leakage, or significant structural cracking. One small cavity (stonelined) exists just below the spillway crest.

- g. Seepage or Leakage. No seepage or leakage was observed relative to the concrete or masonry structures.
- h. Monolith Joints - Construction Joints. No monolith or construction joints were apparent.
- i. Foundation. The foundation at the gatehouse could not be examined due to water levels. The foundation of the spillway is on bedrock and no erosion or distress was noted.
- j. Abutments. Not applicable.

2. EMBANKMENT STRUCTURES

- a. Settlement. The upstream and downstream slopes and the downstream toe area were examined and no settlement, depressions or sinkholes were noted. The crest of the embankment shows no evidence of generalized settlement, however, some depression has occurred where wheel traffic has passed along the dam crest. These depressions are about 6 inches in depth.

Some settlement has also occurred behind the side-walls of the spillway. These depressions are about 3 to 6 inches deep and about 1 foot wide.
- b. Slope Stability. The upstream slope of the dam is true to line and grade and no evidence of instability was found. The downstream slope of the dam is tree covered (6 to 14 inch diameter pine) with no grass growth. The slope is generally in good shape and shows no signs of instability. There is evidence of some miner surficial sloughing at the toe of the dam at approximately Station 5+50.
- c. Seepage. No seepage is evident at the abutments of the dam or on the downstream slope of the dam. Seepage was observed along the toe of the dam from approximately Station 3+50 to 6+00. A mineral spring is present at the 24-inch diameter drain outlet. The volume of seepage was small, estimated total accumulation of only 5 gpm. No piping or erosion was noted. Several groundhog burrows were observed on the downstream slope of the dam near the top. No recent activity was evidenced, however, and the burrows are in elevation above normal pond level. The owner's representative

said that when new burrows are discovered, they are "bombed" to kill the woodchucks. This method has proven very effective.

d. Drainage Systems. No drainage system outlets were found.

e. Slope Protection. The upstream slope of the dam is protected by rip rap which is in excellent condition. However, some downslope creep of the stones was observed east of the service bridge to the gatehouse when it was exposed by low water on September 21, 1978. The downstream slope is wooded by 6 to 14-inch diameter pine trees. The surface cover consists of forest duff, pine needles with a sparse growth of ferns and brush. No erosion is evident on either slope.

3. SPILLWAY STRUCTURE

The spillway consists of a stone masonry chute located near the west abutment of the dam. The spillway is 38.5 feet wide and 5 feet deep below the crest of the dam. Holes exist in the crest of the spillway for the installation of flashboard rods. See the design drawings and Photographs 4 and 6 for details.

a. Control Gates. None.

b. Unlined Saddle Spillways. None.

c. Approach and Outlet Channels. The approach channel is flat and slopes gently toward the pond. It is clear and unobstructed. The outlet channel has a moderate slope (5-10 percent) and low small brush lines the channel. A large tree has fallen into the channel downstream of the spillway. See Photographs 3, 4 and 6.

d. Stilling Basin. Below the spillway crest is a channel paved with stone which is in good condition. One small cavity was observed. See Photograph 3.

4. OUTLET WORKS

The outlet works consist of a cylindrical concrete gate house structure. See Photograph 2. The outlet consists of a 24-inch diameter drain and 16-inch diameter service main.

- a. Intake Structure. The intake structure for the 24-inch and service mains could not be visually inspected due to water levels.
- b. Operating and Emergency Control Gates. The 24-inch diameter drain was not operated and reportedly has not been operated since about 1960 due to concern by the owner regarding closing of the valve. The 16-inch diameter inlets and main valve are reportedly operated as necessary for water supply.
- c. Conduits. The 24-inch diameter drain line was inspected from its outlet end. No leakage was occurring and the pipe was found to be true in line and grade and in good structural condition.
- d. Stilling Basin. No provision for preventing erosion was noted below the 24-inch outlet. Rip rap is shown on the drawings but none was observed.
- e. Approach and Outlet Channels. The approach is not visible due to water levels. The outlet channel is lined with brush and small trees, as shown in Photograph 3.
- f. Drawdown Facilities. The 24-inch diameter outlet gate was not operated during inspection. It has limited capacity (63 cfs) to supplement the spillway.

5. SAFETY AND PERFORMANCE INSTRUMENTATION

None at dam.

6. RESERVOIR

- a. Shore Line. No major active or inactive landslide areas on Mount Zircon Reservoir were observed.
- b. Sedimentation. The watershed has remained essentially rural. There are no new developments or new sources of sediment loads on the reservoir. However, sediment at least 2 feet in depth covers the southerly shore of the reservoir at the inlet end, as shown in Photograph 7.

c. Potential Upstream Hazard Areas. There are no structures adjacent to the reservoir which would be affected by probable maximum flood elevations.

d. Watershed Runoff Potential. The watershed is rural with very few changes in development. Mount Zircon Brook has a very steep gradient (5-10 percent) and a small drainage area (2.6 square miles), which lends it a very quick runoff response.

7. DOWNSTREAM CHANNEL

The outlet channel from Mount Zircon Reservoir is man-made for its first 1000 feet where it joins the old Mount Zircon Brook Channel. Both the man-made channel and brook channel have a steep gradient (5-10 percent) and are rocky with overhanging trees.

8. OPERATION AND MAINTENANCE FEATURES

a. Reservoir Regulation Plan. None.

b. Maintenance. The grass on the upper slopes and top of the dam is mowed and well kept. The trees on the downstream slope are reportedly periodically inspected by a forester and the trees are pruned. Brush is periodically cut along the toe of the dam and in the spillway channel. Other required maintenance is done on an as-needed basis, such as work on the service bridge, spillway masonry and gate house.

APPENDIX B

ENGINEERING DATA

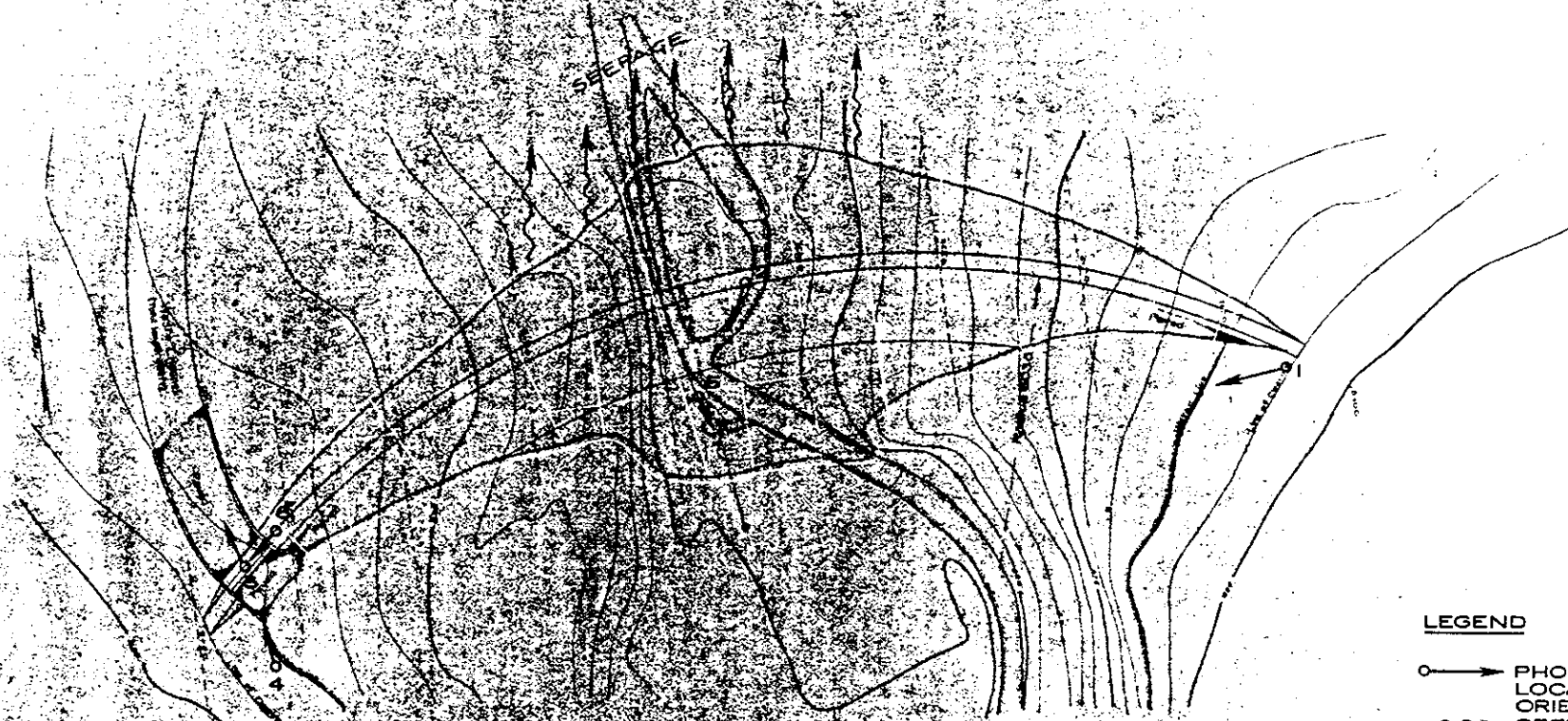
This appendix lists the engineering data collected either from project records or other sources of data developed as a result of the visual inspection. The contents of this appendix are listed below.

<u>Appendix</u>	<u>Description</u>
B-1	General Project Data
B-2	Hydrologic and Hydraulic Data
B-3	Properties of Embankments and Foundation Materials
B-4	Concrete Properties
B-5	Construction History
B-6	Inspection History

APPENDIX B-1

GENERAL PROJECT DATA

Two sets of design drawings by Metcalf and Eddy 1912 and by E. Worthington, Engineer 1913 are available at the Rumford Water District Office. Also available are "Specification, Contract, and Bond for Mount Zircon Brook Supply, March 1913," a construction progress report of February 5, 1914, and construction photographs. A copy of the Worthington Drawings are included in this section.



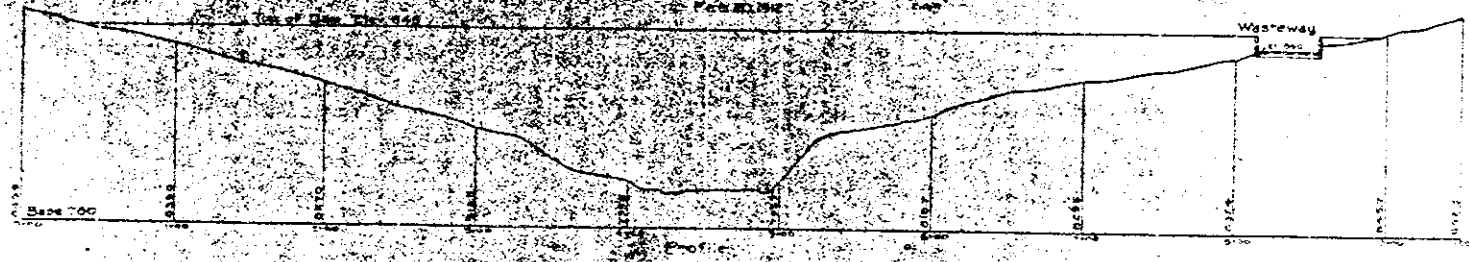
RUMFORD MEXICO WATER DISTRICT

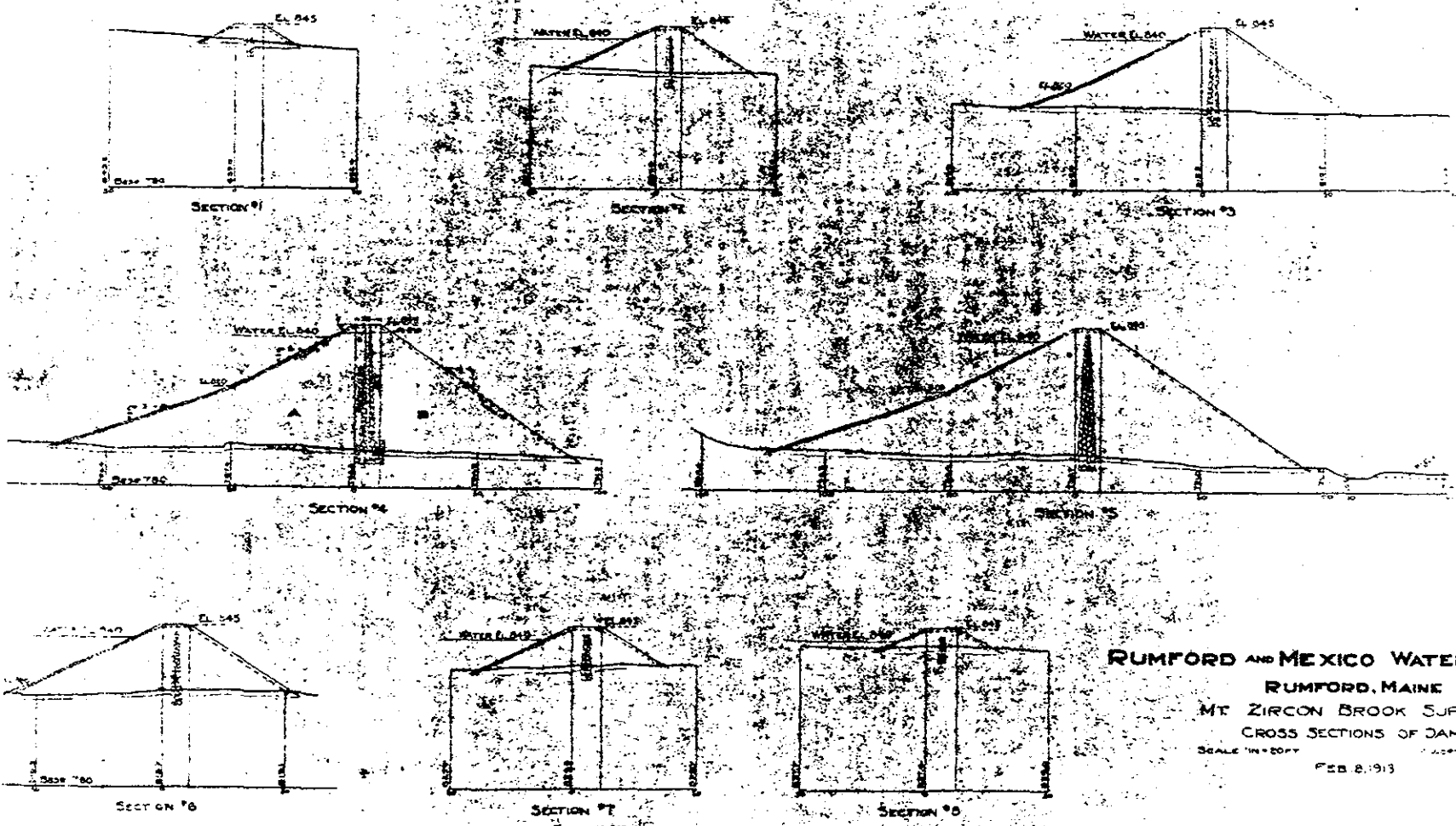
RUMFORD, MAINE

Mt. ZION BROOK SUPPLY

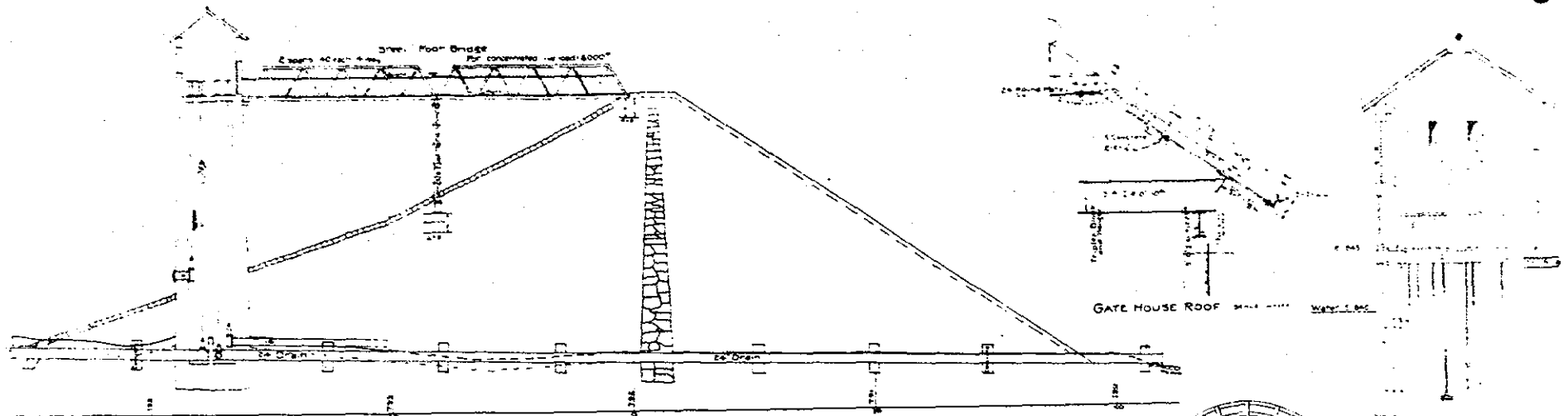
PLAN AND PROFILE OF DAM

DESIGNED BY: H. B. BROWN, JR., CIVIL ENGINEER, RUMFORD, MAINE



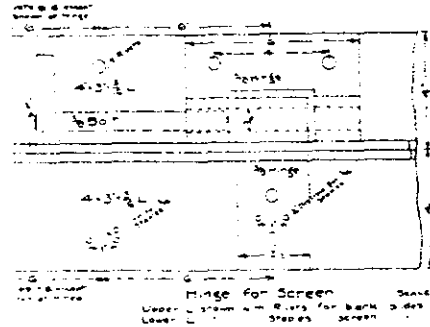


RUMFORD AND MEXICO WATER DISTRICT
RUMFORD, MAINE
MT ZIRCON BROOK SUPPLY
CROSS SECTIONS OF DAM
 SCALE 1"=50' FT
 FEB. 8, 1913

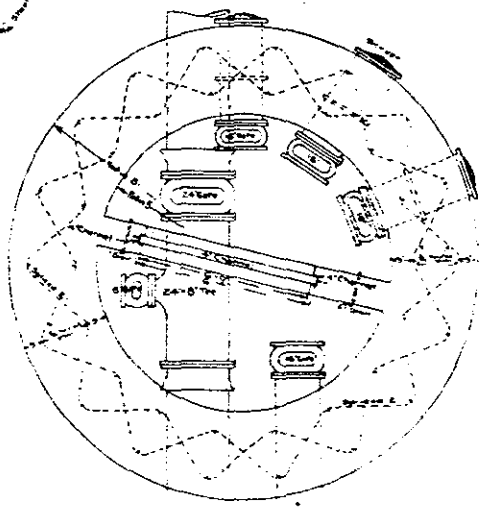
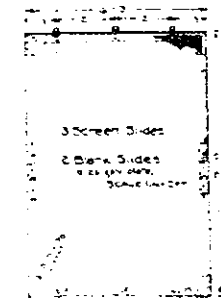


SECTION AT GATEHOUSE
SCALE 1/4" = 1'-0"

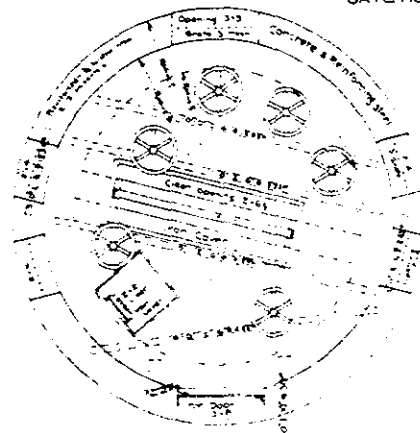
RUMFORD AND MEXICO WATER DISTRICT
RUMFORD, MAINE
MT. ZIRCON BROOK SUPPLY
DETAILS OF GATE HOUSE
SCALES AS NOTED
FEB 20, 1913
E. W. BATHURSTON



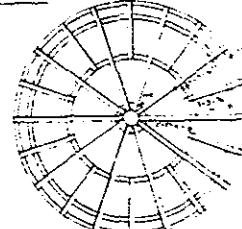
DETAILS OF SCREENS



PLAN OF VALVE CHAMBER IN GATE HOUSE
Scale 1/4" = 1'-0"



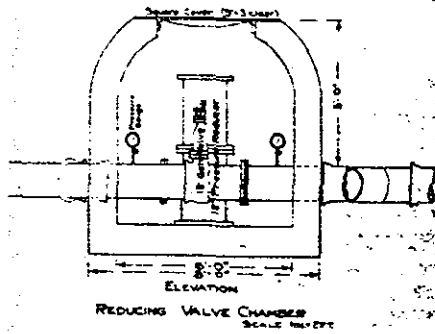
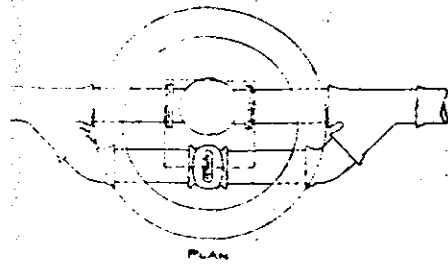
PLAN OF GATE HOUSE FLOOR
Scale 1/4" = 1'-0"



Framing Plan
GATE HOUSE ROOF

B-1.4

ELEVATION OF GATEHOUSE



RUMFORD AND MEXICO WATER DISTRICT

RUMFORD, MAINE

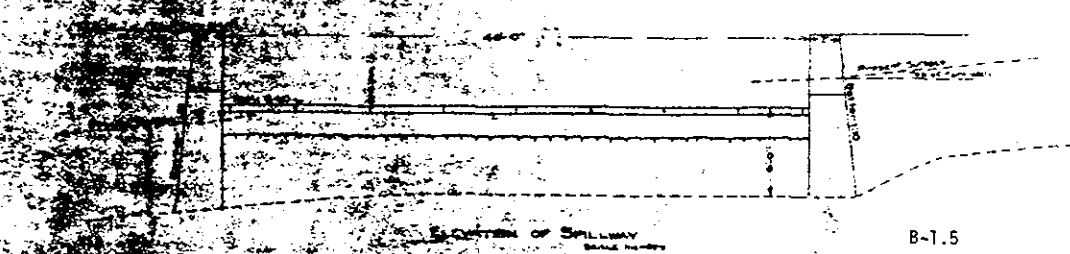
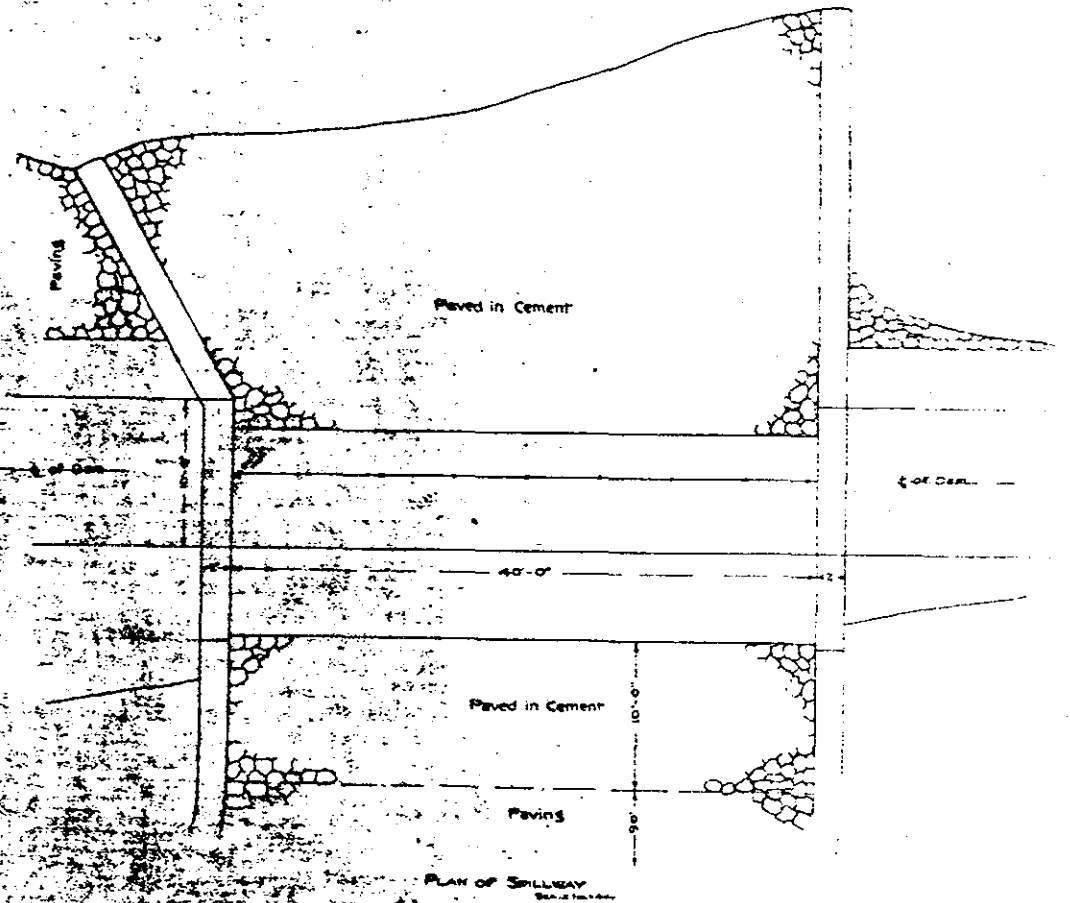
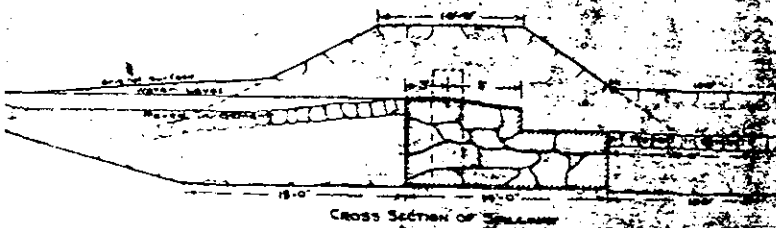
MT. ZIRCON BROOK SUPPLY

SPILLWAY AND REDUCING VALVE CHAMBER

SCALES AS NOTED

FEB. 22, 1913

E. WOODBURY



APPENDIX B-2

HYDROLOGIC AND HYDRAULIC DATA

Two letter reports concerning the hydrology and hydraulics of Mount Zircon Reservoir Dam were made available by the Rumford Water District. Both reports had been submitted by E. Worthington, Civil and Consulting Engineer, Dedham, Mass. The first report was written in March, 1915, less than a year after the reservoir construction had been completed. The second report was written in September, 1928 and described the condition of the dam at that time. Elevations listed in this report are referenced to USGS mean sea level datum.

1. The drainage area contributing to Mount Zircon Reservoir Dam is about 2.6 square miles. Mount Zircon Reservoir itself has a surface area of approximately 18.2 square miles.
2. The pool elevation of the top of the conservative or normal pool is taken as elevation 840.0 feet.
3. Storage capacity at the top of the normal pool is taken as 307 acre-feet.
4. The elevation of the top of the flood control pool is taken as elevation 845.0 feet.
5. The storage capacity (incremental) of the flood control pool is about 132 acre-feet.
6. The elevation of the maximum design pool is unknown.
7. Surcharge capacity is unknown.
8. There is no freeboard available at the assumed flood control elevation.
9. The elevation of the top of the dam is 845.0 feet.
10. The elevation of the spillway is 840.0 feet, and the length is 38.5 feet. The shape of the spillway is broad crested as shown in Appendix B-1, X-sections.

11. There is one gate which is 24 inches in diameter. The upstream invert is about elevation 791.8 feet, and the downstream invert is about elevation 790.0 feet.
12. There is no emergency spillway.
13. There is provision for flashboards, but none are used.
14. The elevation of the top of the earth embankment dam is about 845.0 feet.
15. There are no identified hydrometeorological gages in the watershed.
16. Mount Zircon Brook has a very steep gradient (about 5 to 10 percent) and flows in a narrow flood plain for most of its length to the Androscoggin River.

APPENDIX B-3

PROPERTIES OF EMBANKMENT AND FOUNDATION MATERIALS

The properties of embankment materials and foundation materials anticipated prior to construction are given in the specifications referenced in Appendix B-1.

APPENDIX B-4
CONCRETE PROPERTIES

The properties of the concrete to be used in the construction of the dam are given in the specifications referenced in Appendix B-1.

APPENDIX B-5

CONSTRUCTION HISTORY

A copy of a construction progress report by Mr. E. Worthington dated March 27, 1915, and copies of construction progress photographs are available at the Rumford Water District Office.

APPENDIX B-6

INSPECTION HISTORY

A post construction inspection and review of the dam was made by Mr. E. Worthington on June 11, 1928. A copy of his report is included in this section.

On February 17, 1978, an inspection was made by Maine Department of Transportation personnel. A copy of their report is attached.

File

E. WORTHINGTON
Steel and Consulting Engineer
WATER SUPPLY AND SEWERAGE
INSURANCE BUILDING
DEDHAM - MASS.

TELEPHONE, DEDHAM 120

DEDHAM, MASS., September 17, 1928

Mr. John P. Macgregor,
Treasurer Rumford & Mexico Water District,
Rumford, Maine.

My dear Mr. Macgregor,

On June 11, 1928 I had various levels taken at Mount Zircon dam and submit the following report.

The following table of data may be well to consider at the outset.

Area of watershed	2.6 square miles.
Area of reservoir	18.2 acres
Elevation of overflow	840.0
Elevation of top of dam	845.0
Elevation summit of Mt. Zircon	2850
Elevation of Hemingway Mountain	1900
Elevation summit of Bean Mountain	1850
Average slope of watershed	1000 feet per mile
Contents of reservoir in one foot of depth at overflow level.	1,000,000 cubic feet.

One inch of rainfall is 6,000,000 cubic feet on the drainage basin.

One inch per 24 hours is 70 cubic feet per second on the basin.

The top of the embankments in general was fairly well up to the original levels and in places slightly over. A line of stakes and grades was set to which it was considered advisable to bring the top. Elevation 845.2 was placed on them which is about 2 inches higher than the original dam. It is advised that the surface of the dam be always kept to this grade so no sags occur. A slight drop at one point due to rain washing away the earth is to be avoided. There was a place about three feet east of the spillway which had become lowered four inches below its original level or to 844.7.

The northerly support to the bridge had dropped 0.82 feet due

COPY

to settling under frost and ice action. This is a shallow block of concrete whose base is not below frost. The middle pier has not settled at all and of course the gate base has not settled. The levels are all checked to solid ledge benches. The top of the stone paving was originally set at 841.0 and is about the same today varying from 841.0 to 842.5 but there were no exact elevations taken in 1914. There is practically no growth of the paving due to frost and surface settlement on the water face. There can be no settlement of the concrete core wall as it is on ledge across most of the dam.

There appeared to be no leakage through the dam as far as could be seen. In the construction of the dam a small spring was discovered above the core wall on the easterly part of the dam and a pipe was left to prevent its building up a pressure and softening the soil above the core wall. The water from it has a high iron content and soon turns red on contact with the air. The spring comes through a fairly coarse blue sand layer not over a few inches deep which extends along the east face of the reservoir. This strata was supplying a moist streak when the dam was constructed and does not seem to be changed any today. Its chief outlet is into the reservoir several hundred feet above the dam where it is now very muddy water. I can discover no change in its character since 1914. At that time the pipe was running into a small pool of red water and it is now doing the same. No measurements were made in 1928 of the amount of flow. In November 1914 about 2000 gallons per day were flowing from the pipe. There is a certain amount of moisture on the downstream face of the dam such as is found on all earth dams but it has only been enough to show as a growth of grass and horsetails which live in damp soil and there seems to be no sliding of the bank.

The quantity of the spillway has been investigated. The section of this overflow is shown on the print attached. There have been various

experiments made on the flow over dams but the Cornell experiments cover the complete summing up of the tests to date.

The simplest quantity formula is $Q = C L H^{3/2}$ where

Q = Flow cubic feet per second
C is a factor depending on shape of dam
L is length of overflow
H is height of water in feet.

The Cornell results as cited for their series 42, 43, 44 and 45, of which series 44 is nearest to Mt. Zircon conditions, gives a value of C of 2.64. The following table gives the flows in cubic feet per second for various depths on the spillway at 40 feet in length.

Elevation	Depth	C.F.P.S.	Inches per 24 hours
840.0	0.0	0	0
840.5	0.5	37	0.5
841.0	1.0	106	1.5
841.5	1.5	194	2.8
842.0	2.0	299	4.4
842.5	2.5	416	6.0
843.0	3.0	548	7.8
843.5	3.5	692	9.9
844.0	4.0	844	12.1
844.5	4.5	1008	14.4
845.0	5.0	1180	16.9

The rainfall rate of the Vermont flood was the record breaker of Northern New England and at Somerset amounted to 8.77 inches per 24 hours. The storm of 1869 had a greater total fall in southern New England but the flood results in general were no greater. There seems to be evidence that the 1927 Vermont flood produced a runoff rate of 12 inches per day or 0.5 inches per hour over a very small area. At the same time there was a rainfall rate of 0.62 inches per hour which is a rainfall rate of 15 inches per day. This lasted less than six hours at that rate. This would fill your spillway 4.0 feet deep. The absolute limit of your spillway is now a rate of 16 inches runoff per day or 0.67 inches per hour of steady flow. It could stand an hour runoff of 1.6 inches if starting from just

running over and then hold its own at a runoff of 0.67 inches per hour there after.

There are flood marks of debris at Mt. Zircon dam which are at elevation 843.2 to 843.4. This indicates a water line of about 3.4 feet on the spillway during a storm in 1927. This is due to a runoff rate of about 9.5 inches per day and compares with a limit of spillway capacity of about 17 inches per day. The presence of ice on the pond at the time of a flood would seriously interfere with the spillway capacity. Cloudbursts are a summer occurrence and vegetation greatly reduces the runoff rate compared with the rate of rainfall but no exact figures can be quoted for New England.

There are two possibilities for increasing your spillway capacity. You may lengthen it to the westward and it will carry just that much more water. The spillway channel will carry much more water than now comes to it over the overflow. This will need no new plan but you should tear out the present westerly abutment and go back toward the west end of the dam and build on the ledge which you will soon strike, to form a new abutment. The amount of work advisable depends entirely on the amount of ledge you encounter. At the west abutment as now existing, ledge outcrops at 838.0 in places and runs up to the west. You should cut out the soft places in the ledge and cut out a trench in the ledge to get a tight job. If it were not so difficult to get crushed stone or gravel at the dam I would advise shaping this extension in concrete for the sake of tightness. Careful work with stone if the joints are well filled will prevent leaks though this requires care and use of plenty of mortar to make a solid job. A sketch is enclosed to indicate the work to be done.

A second method of increasing the capacity of your spillway is to increase the discharge coefficient. A very slight change in the shape of the spillway will increase the flow materially.

Where the upstream face of a spillway has a gradual slope for the approach of the water the capacity is greatly increased. A rounding of the upstream edge by a four inch radius will let 10 or 15 percent more water overflow. The most perfectly designed overflow may yield 50 percent more than the one which you now have but cost more than it is worth to install. A suggested rounding by the adding of a block of concrete (about 8 cubic yards) is shown on the sketch and would increase the spillway capacity about 30 percent in the high flows. This avoids lengthening your overflow. This opinion is based on the Cornell experiments, which while not covering exactly the same shape does suggest the probable result.

If you consider that you have the money available you might well follow both the lengthening and reshaping methods. If you look at the expense largely I would advise the rounding of the approach to the spillway as being cheaper.

I would strongly advise against flashboards. A five foot legway is none too much and automatic falling flashboards form an obstruction to your flow which under ice conditions and sudden thaws can only cause trouble. Permanent flashboards should not be thought of and removable ones are too far from hand attention.

I add a table of probable spillway capacities if the rounding is made. C is assumed as 3.33.

Elevation	Depth	C.F.P.S.	Runoff Inches per day
840.0	0.0	0	0
840.5	0.5	47	0.7
841.0	1.0	133	1.9
841.5	1.5	245	3.5
842.0	2.0	377	5.4
842.5	2.5	526	7.5
843.0	3.0	692	9.9
843.5	3.5	872	12.5
844.0	4.0	1065	15.2
844.5	4.5	1272	18.1
845.0	5.0	1490	21.3

At any time when it seems as if there was danger to the dam from a great height of water an added outlet can be obtained by opening the 24 inch gate. This pipe is anchored in heavy piers every six feet to withstand the pressure and the vibration in its use. The 24 inch pipe will deliver about 120 cubic feet per second which may help in some cases.

There has been a slight spalling of the concrete at the gate house due to water and ice action. This is not at all serious or unexpected and should cause no leakage. The gate house is over two feet thick at that point. To avoid ice pressure this part should be pointed up and smoothed over with a rich mixture of cement.

Your attention is called to the downstream slope. Wherever there are pockets at the edge of the slope such as those near the spillway and near the 24 inch main where water is held and prevented from running off freely, they should be filled so the surface will be drained. This is to prevent a softening of the bank with a possibility of a slight running of the surface loam. As solid a coat of grass as possible should be kept on the slope to prevent wash as the bank is very steep and would wash easily if a start was made in it. There are no signs as yet of trouble after fourteen years but this is an important detail of maintenance.

In brief, Mr. Zircon dam seems to be in good condition. The spillway would have withstood the Vermont flood under the Vermont conditions but have been severely tried if there had been ice in the pond. It will stand an extreme summer torrent. It can be cheaply brought to a greater degree of safety by reshaping the spillway and this should be done. It can be further improved by lengthening the spillway. Flashboards are too likely to obstruct and lower the flood capacity and are likely to cause great damage. They should not be installed on this earthen dam.

All depressions on the downstream edge of the dam should be filled and the top of the dam be graded to 845.2 and maintained at that height. The gate house should be smoothed up to avoid ice lifting.

Yours truly,

E. Worthington

COPY

INSPECTION REPORT
FOR THE MT. ZIRCON RESERVOIR DAM, RUMFORD

On February 17, 1978, Everett Barnard, Assistant Bridge Maintenance Engineer; Philip J. Libby, Structural Project Design Engineer; Guy Baker, Assistant Soils Engineer; and Charles Norburg, Geologist, met with Mr. Hector LeCours, Superintendent for the Rumford Water District, at his office on Spruce Street. He showed us a photograph album that recorded the construction of the dam in 1914. The pictures showed a concrete core placed in the middle of the earthwork which makes the dam. Mr. LeCours stated that the dam floods 21 acres and has a maximum depth of 47'. The earth borrow for the dam was taken from within the flooded areas, thereby increasing the volume of the 108 million gallon reservoir. The dam was designed by Fay, Spofford & Thorndike, Boston, Massachusetts. Mr. LeCours said he would look for general plans of the dam which we might reproduce for our files, these are to be mailed to me at a later date, however, the photographic record kept on file at the Water District office, show the progress and construction features of the dam.

An employee was assigned to our party to show us the site. Deep snow required the use of snowmobiles to travel $\frac{1}{2}$ mile from the road to the site.

The dam impounds the flow of Zircon Brook in a reservoir, that covers 21 acres and has a maximum depth of 47' and contains 110+ million gallons. The reservoir has a spillway, that is 5' or 6' lower than the crest of the earthwork, on the West end of the structure. There were grooves in spillway walls for stop logs but none were used at this time.

Mr. LeCours said that the flow from the water shed was adequate until extreme dry weather is encountered, at which time the water level will become lower than the spillway. The lowest level on record was about 20' below spillway elevation recorded 1949.

The water shed upstream from the dam is of constant size and the run off does not exceed the size of the spillway. There is only one stand of farm buildings within the flood plain of Zircon Brook. This is at least $\frac{1}{2}$ mile below the reservoir and is also in the area that has leveled itself near the Androscoggin River. The Androscoggin River is large enough so that the flow from Zircon Stream Reservoir will not flood it.

The deep snow prevented any visual indication of seepage at the dam site, but there was no apparent problem and the location does not pose any threat to the downstream area.

Reported by _____

Philip J. Libby

2/17/78

BEDROCK REPORT

—NAME: Mt. Zircon Reservoir Dam

TOWN: Rumford COUNTY: Oxford

—RIVER: Zircon Brook

TYPE OF DAM: Earth Gravity

—PURPOSE: Water Supply

HEIGHT(FT.): 52

—CAPACITY(ACRE FT.): 3797

—UNDERLYING BEDROCK: Gray Biotite and Muscovite Gneiss and Schist

SITUATION: This dam is in a moderate damage earthquake area (seismic zone 2) which is considered to present little or no hazard from earthquake. The nearest known earthquake epicenter was over 20 miles distant near Madrid. It was of unknown intensity.

According to a Rumford Water Company official, the dam is placed on bedrock. Bedrock outcrops are reported in the area, but due to a heavy snow cover, they could not be located for identification. No known faults are located at the dam site.

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APPENDIX C
PHOTOGRAPHS

The following are photographs referenced in this report.
See sheet B-1.2 for photograph locations and orientations.



1

VIEW OF DAM FROM EAST END



2

CONTROL GATE HOUSE



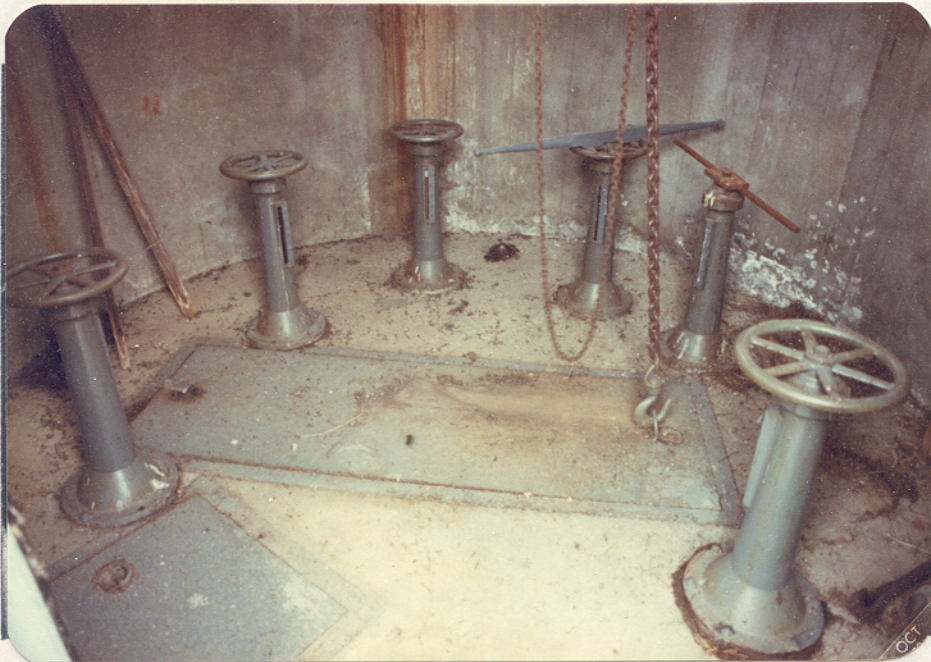
3

SPILLWAY DISCHARGE CHANNEL



4

SPILLWAY



5

GATE CONTROL MECHANISM IN GATE HOUSE



6

SPILLWAY CREST



7

SILT DEPOSITS AT INLET TO RESERVOIR

APPENDIX D

HYDROLOGIC AND HYDRAULIC DETERMINATIONS

Two letter reports concerning the hydrology and hydraulics of Mount Zircon Reservoir Dam were located. The first is a brief report concerning the construction and startup of the reservoir, and the second is a progress report written 13 years after startup. An analysis has been made which includes a hazard determination, estimation of full spillway discharge, and overtopping potential. Tailwater rating curves are not available due to lack of channel configuration data. Flood flow discharges from Mount Zircon Reservoir Dam were calculated by using USGS regional frequency formulas. The hydrologic map of the watershed is reproduced as the location map.

PROJECT	COMP BY	JOB NO.
	MEM	20583 06
Maximum Probable Flood - Mt. Dixon	CHK BY	DATE
	BTB	8-9-78

Watershed Area = 2.58 Sq Mi

Using Figure From:

"Preliminary Guidance For Estimating
Maximum Probable Discharges in
Phase I Dam Safety Investigations

$$MPF = 2100 \text{ CFS/SQ MI}$$

$$\text{or } MPF = 2.58 \times 2100 = \underline{\underline{5418 \text{ CFS}}}$$

PROJECT USGS Regional Frequency Formulas	COMP BY MEM	JOB NO. 20506 06
	CHK BY STB	DATE Aug. 9

$$P_{10} = 26.9 (D.A.)^{.936} (m)^{.315} (\text{storage})^{-.252}$$

$$P_{50} = 42.7 (D.A.)^{.915} (m)^{.346} (\text{storage})^{-.275}$$

$$P_{100} = 50.9 (D.A.)^{.907} (m)^{.358} (\text{storage})^{-.282}$$

$$P_{25} = 35.6 (D.A.)^{.923} (m)^{.333} (\text{storage})^{-.266}$$

$$P_{500} = 10^{3.69 \log(P_{25}/P_{10}) + \log P_{10}}$$

Storage of lakes + ponds + 1%

D.A. = Drainage Area (mi²)

m = slope ft/mi

$$P_{500} = 10^{3.69 \log(P_{25}/P_{10}) + \log P_{10}}$$

PROJECT	COMP BY	JOB NO.
	MEM	20583 06
	CHK BY	DATE
FLOOD FLOWS	BTB	8-18-78

$$D.A = 2.6 \text{ S, Mi, } m = 1000 \text{ ft/mi}$$

$$\text{Storage} = \left(\frac{0.03}{2.6} \right) (100) + 1 = 2.15$$

$$P_{10} = 26.9 (2.6)^{0.936} (1000)^{0.315} (2.15)^{-0.252}$$

$$P_{10} = 478 \text{ CFS}$$

$$P_{50} = 42.7 (2.6)^{0.915} (1000)^{0.346} (2.15)^{-0.275}$$

$$P_{50} = 905 \text{ CFS}$$

$$P_{100} = 50.9 (2.6)^{0.907} (1000)^{0.358} (2.15)^{-0.282}$$

$$P_{100} = 1157 \text{ CFS}$$

$$P_{25} = 35.6 (2.6)^{0.923} (1000)^{0.333} (2.15)^{-0.266}$$

$$P_{25} = 700 \text{ CFS}$$

$$P_{500} = 10 \text{ EXP} \left(3.69 \log \left(\frac{700}{478} \right) + \log 478 \right)$$

$$P_{500} = 1953 \text{ CFS}$$

PROJECT Mt. Zircon Brook Dam Hydraulics	COMP BY MEN	JOB NO. 2058366
	CHK BY BTB	DATE 8-9-78

$$Q = CLH^{3/2}$$

Water Surface Elev.	* ¹ Weir @ Q, cfs	* ² Weir @ Q, cfs	PIPE Q, cfs	Total Weir Q, cfs	S acre-ft
840	0	0	63	63	0
840.5	36	0		99	9.6
841	101	0		164	19.2
841.5	186	0		249	28.8
842	286	0		349	38.4
842.5	400	0		463	48.0
843	526	0		589	57.6
843.5	663	0		726	67.2
844	810	0		873	76.8
844.5	967	0		1030	86.4
→ 845	1132	519		1714	96.0
845.5	1306	1752		3121	105.6
846	1488	3398		4949	115.2
846.5	1678	5213		7114	124.8
847	1875				
847.5	2080				
848	2291				
848.5	2509				
849	2734				
849.5	2965				
850	3202				

$$*^1 C = 2.63, L = 38.5, *^2 C = 2.63, L = 780'$$

Total Weir Value exceeds 5418 CFS @ 846.5 ft.

$$.03 \text{ mi}^2 = \frac{(5280)^2}{1 \text{ mi}^2} \left(\frac{1 \text{ acre}}{640000} \right)$$

$$D.A. = 19.2 \text{ acres}$$

$$*^1 C = 2.63, L = 38.5; *^2 C = 2.63, L = 780'$$

PROJECT	Mt Zircon Brook Hydraulics	COMP BY	JOB NO.
		MEM	2058306
		CHK BY	DATE
		BTB	8-9-78

Q for 24" diameter pipe @ elev. 794'

1) Using Outlet Control Nomograph:

$$D = 24" \quad L = 150' \quad (\text{approx})$$

$$H = 50'$$

$$Q = 63 \text{ CFS}$$

2) Using Inlet Control Nomograph:

$$Q = 375 \text{ CFS}$$

3) Using Orifice Equation:

$$Q = ca \sqrt{2gh}$$

$$c = 0.7$$

$$a = \pi r^2 = \pi (12)^2 \frac{1}{144} = 3.14 \text{ ft}^2$$

$$g = 32.174$$

$$h = (\text{water surface}) - (\text{elev @ } \phi \text{ pipe})$$

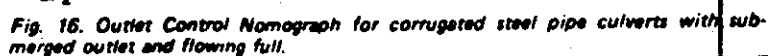
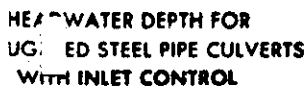
$$= 845 - 794 = 51'$$

$$Q = 0.7(3.14) \sqrt{2(32.174)(51)}$$

$$Q = 126 \text{ CFS}$$

Choose $Q = 63 \text{ CFS}$ ✓

ASSUME PIPE IS
CLOSED



LENGTH ADJUSTMENT FOR IMPROVED HYDRAULICS		
Pipe Diameter in Inches	Roughness Factor n' for Helical Corr. *	Length Adjustment Factor $\left(\frac{n'}{n}\right)^2$
12	.011	.21
24	.016	.44
36	.019	.61
48	.020	.70

*Other values of roughness, n , are applicable to paved pipe, lined pipe and pipe with 3 x 1 in. corrugations. See page 31. To use the above chart for these types of pipe and pipe-arches, use "adjusted length factors" computed per the equation, page 29.

test-type culverts

PROJECT Capacity Mt. Zion Reservoir	S	COMP BY	JOB NO.
		MEM	20503 of
		CHK BY	DATE
		BTB	August 11, 1978

(Information from Report March 27, 1915, E Worthington

Elevation above Sea level	Net capacity gallons	Net capacity * acre-ft	Acres
815.0	7,000,000	21.5	
820.0	17,000,000	52.2	
825.0	31,000,000	95.1	
830.0	49,000,000	150.4	
835.0	72,000,000	221.0	
838.0	77,000,000	236.3	
837.0	82,000,000	251.7	
838.0	87,000,000	267.0	
839.0	93,000,000	285.4	
840.0	100,000,000	306.9	18.2
841.5	110,000,000	337.6	
845.0		5 439.	22.2 Acres

$$*1 \text{ gal} = (1 \text{ gal}) \left(\frac{1 \text{ ft}^3}{7.48 \text{ gal}} \right) \left(\frac{1 \text{ acre}}{43560 \text{ ft}^2} \right) = 3.0691 \times 10^{-6} \text{ acre-ft}$$

PROJECT ROUTING OF MPF	COMP BY MEM	JOB NO. 2058206
	CHK BY BTB	DATE 8-18-78

$$Q_{p1} = 5418 \text{ CFS}$$

$$\text{SURCHARGE HT} = 6.11' \text{ or Elev. } 846.11$$

USING C.O.E REFERENCE :

"ESTIMATING EFFECT OF SURCHARGE STORAGE ON MAX. PROB. DISCHARGE."

$$\text{STOR}_1 = 0.03 \text{ mi}^2 \left[\frac{(5280 \text{ ft})^2}{1 \text{ mi}^2} \right] \left[\frac{1 \text{ acre}}{43560 \text{ ft}^2} \right] (6.11 \text{ ft})$$

$$\text{STOR}_1 = 117 \text{ Acre-Feet}$$

$$\text{STOR}_1 = \frac{117 \text{ Acre-Ft}}{640 \times 2.6} \left(\frac{12 \text{ inches}}{\text{ft}} \right) = \underline{\underline{0.846 \text{ inches}}}$$

$$Q_{p2} = Q_{p1} \times \left(1 - \frac{\text{STOR}_1}{19} \right)$$

$$Q_{p2} = 5418 \left(1 - \frac{0.846}{19} \right) = 5178 \text{ CFS}$$

$$\text{SURCHARGE HT} = 6.05'$$

$$\begin{aligned} \text{STOR}_2 &= 0.03 \left[\frac{(5280)^2}{43560} \right] 6.05 \\ &= 116 \text{ acre-ft} \end{aligned}$$

$$\text{STOR}_{\text{AVE}} = 116.5 \text{ Acre-Ft}$$

$$\text{STOR}_{\text{AVE}} = \frac{116.5}{640 \times 2.6} (12) = \underline{\underline{0.842 \text{ inches}}}$$

PROJECT ROUTING OF MPF	COMP BY MFM	JOB NO. 2058306
	CHK BY BTB	DATE 8-18-78

$$Q_{p3} = 5418 \left(1 - \frac{0.842}{19} \right) = \underline{\underline{5178 \text{ cfs}}}$$

PROJECT DAM FAILURE PROBLEM	COMP BY BTB	JOB NO. 2058306
	CHK BY JAF	DATE 9-14-78

$$Q_{p1} = \frac{8}{27} W_b \sqrt{g} Y_0^{3/2}$$

Assume Failure in center of dam

$$W_b = 200'$$

$$Y_0 = 20' \text{ (RE: SLIDE FAILURE)}$$

$$Q_{p1} = \frac{8}{27} 200 (\sqrt{g}) 20^{3/2} = \underline{\underline{30,100 \text{ CFS}}}$$

$$\frac{1}{2} Q_p T = 12.1 S$$

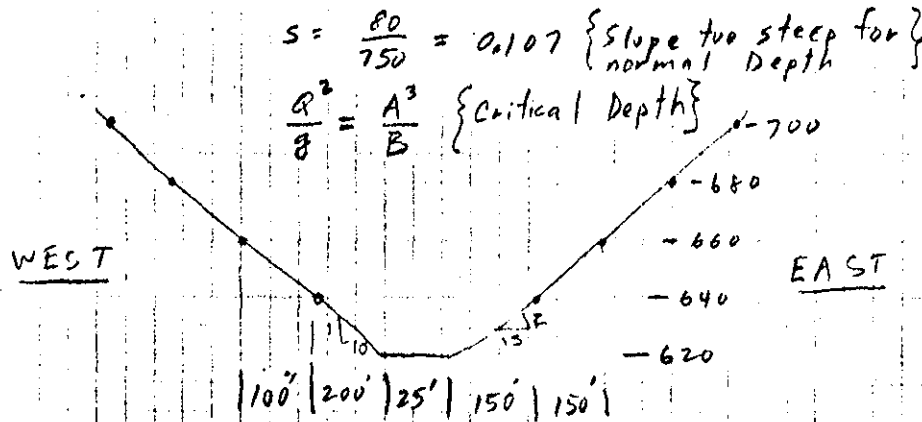
$Y_0 = 20' \therefore$ USE TOP 20' OF STORAGE

$$S = 439 - 95 = \underline{\underline{344 \text{ AC-FT}}}$$

$$T = \frac{12.1 (344) (2)}{30,100} = \underline{\underline{0.277 \text{ hr}}}$$

or 16.6 minutes

PROJECT	SECTION ①	COMP BY	JTB	JOB NO.	2058306
RATING CURVE - 2150' from dam		CHK BY	JTB	DATE	9-14-78



$V = A \times L \quad (L = 2150')$

ELEV.	ft ² AREA	Q, cfs	V, fps	AL-ft STORAGE, V
620	0	0	0	0
625	344	3410	9.9	17.
630	1125	15140	13.5	55.5
633	1804	18707		89.0
634	2065	32406		101.9
635	2344	37973		115.7

PROJECT	DAM FAILURE PROBLEM	COMP BY	JOB NO.
		BTL	2-058306
		CHK BY	DATE
		JWP	9-14-78

$$Q_{p1} = 30,100 \text{ cfs}$$

$$\begin{aligned}
 Q_{p2} (\text{TRIAL}) &= Q_{p1} \left(1 - \frac{V_1}{S}\right) \\
 &= 30,100 \left(1 - \frac{99.7}{344}\right) \\
 &= 21,376
 \end{aligned}$$

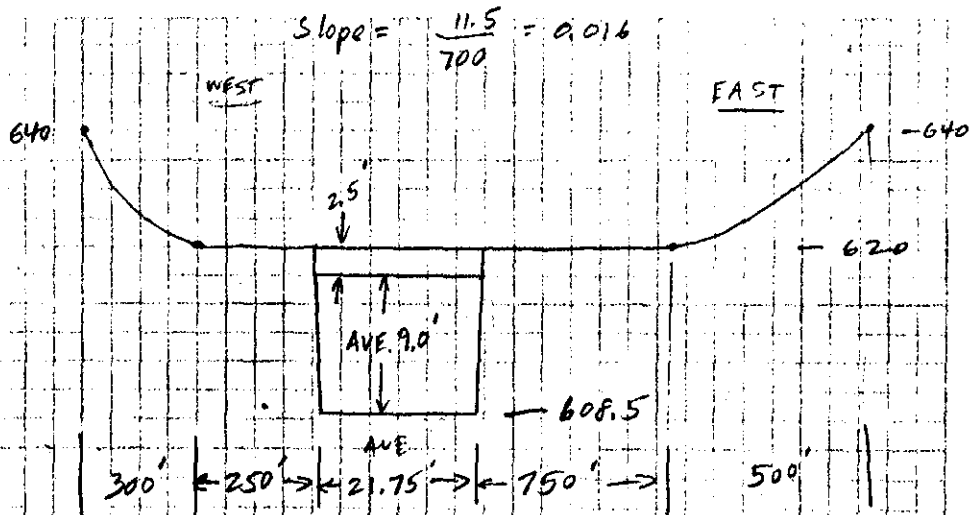
$$V_2 = 91.5 \quad \text{AVE } V = 95.6$$

$$Q_{p2} = 30,100 \left(1 - \frac{95.6}{344}\right) = \underline{\underline{21,700 \text{ cfs}}}$$

$$\text{STAGE} = 633.2$$

$$\text{DEPTH} = 13.2'$$

PROJECT	SECTION ② RATING CURVE AT MT. ZIRCON ROAD BRIDGE - 750' from Section ①	COMP BY	JOB NO.
		BTP	20583 06
		CHK BY	DATE
		JNP	9-14-78



channel $n = 0.045$

overbank $n = 0.07$

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

ELEV.	AREA, ft^2	Q, cfs	V, fps	STORAGE, V
620	1194	1740	9.0	3.3
625	5530	41867	8.0	91.2
621				
622	2044	8715	4.3	35.2
623	3066	18871	6.1	52.8
624	4282	29414	6.9	73.7

$$L = 750'$$

$$V = A \times L$$

$$A = ft.$$

$$STORAGE, V$$

$\frac{L}{43560} PCU$

PROJECT DAM FAILURE PROBLEM	COMP BY BTB	JOB NO. 20583 06
	CHK BY JNF	DATE 9-15-78

$$Q_{p2} = 21,700 \text{ cfs}$$

$$Q_{p3} (\text{TRIAL}) = Q_{p2} \left(1 - \frac{V_1}{S}\right)$$

$$= 21,700 \left(1 - \frac{54.8}{344}\right)$$

$$= 18,243$$

$$V_2 = 51.7$$

$$\text{AVE } V = 53.2$$

$$Q_{p3} = 21,700 \left(1 - \frac{53.2}{344}\right) \approx \underline{18,300 \text{ cfs}}$$

$$\text{STAGE} = 622.9$$

Flood plain width $\approx 1000'$

≈ 3 house inundated.

APPENDIX E
INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS

NEW

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR. DIST.	STATE	COUNTY	CONGR. DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
ME	244	NED	ME	017	02				MOUNT ZIRCON RESERVOIR DAM	4430.0	7034.0	18OCT78

POPULAR NAME	NAME OF IMPOUNDMENT
	MOUNT ZIRCON RESERVOIR

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	03	ZIRCON BROOK	RUMFORD	3	9000

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUC. HEIGHT (FT.)	HYDRAU. HEIGHT (FT.)	IMPOUNDING CAPACITIES	
					MAXIMUM (ACRE-FT.)	NORMAL (ACRE-FT.)
REGROTPG	1914	S	57	52	440	300

DIST DWN FED R PRV/FED SCS A VER/DATE

NED N N N N 18OCT78

REMARKS

(5)	(2)	(1)	(2)	(3)	(4)	(2)	(3)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
D/S HAS	SPILLWAY			MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY		NAVIGATION LOCKS							
	CREST LENGTH	TYPE	WIDTH (FT.)			INSTALLED (MW)	PROPOSED (MW)	NO.	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	
2	900	U	39	1720	61000										

OWNER	ENGINEERING BY	CONSTRUCTION BY
RUMFORD WATER DIST.		

REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	NONE

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
EDWARD C. JORDAN CO. INC.	01AUG78	PL 92-367

REMARKS